



Ministry of the Environment
Water Resources Branch
Limnology and Toxicity Section
TOXICITY UNIT

THE ONTARIO WATER RESOURCES COMMISSION

REPORT ON

A STUDY OF THE FLAVOUR OF FISH

FROM THE FISH AND FISH PRODUCTS OF THE GREAT LAKES

by

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Biology Branch

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REPORT

On

A STUDY OF THE FLAVOUR OF FISH
FROM THE SPANISH RIVER AND ADJACENT NORTH CHANNEL

By

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December 14, 1965

A STUDY OF THE FLAVOUR OF FISH
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Since 1947 complaints have been made by commercial fisherman and others of the odour of the water and foul taste of fish from the Spanish River downstream of Espanola. The odour was alleged to have been that peculiar to the K.V.P. (Kalamazoo Vegetable Parchment Co., Ltd.) plant which began operations at Espanola in 1946. The plant produces Kraft and groundwood pulps which are used in the manufacture of paper products. During recent years an average of 16,000,000 Imp.GPD of waste materials were discharged to the Spanish River.

The Research Council of Ontario undertook a study of chemical, physical and biological conditions in the river in 1950. The results of this study (Dymond and De Laporte, 1952) confirmed the existence of odour in the water and foreign flavour in the major game fish in the river, the yellow pickerel (Stizostedion vitreum vitreum).

Since its inception, the OWRC has been cognizant of the problems of pollution in the Spanish River, has made frequent surveys and offered suggestions to K.V.P. on improvements in waste treatment.

In 1958, personnel of the OWRC investigated a complaint from a commercial fisherman that fish caught in the river near its mouth had been rejected by buyers in Sudbury, Montreal and New York on the basis of an objectionable flavour described as "carbolic" (Voegelé, 1958). Analyses for phenols showed the presence of

6 and 7 ppb in water at the fishing site but none in pickerel from the same location. The fish, however, yielded 1 to 25 ppm tannins, indicating that other wastes of an odourous nature could have been absorbed also.

In a letter to the Commission regarding this investigation, Mr. W.J. Sullivan, K.V.P. Company stated that most of the taste and odour problem would stem from two waste streams: the turpentine decanter underflow and the hot water accumulator overflow. Subsequently, attempts were made to eliminate the turpentine decanter underflow from the final effluent. This was accomplished by 1960. The hot water accumulator overflow was re-directed by the spring of 1965.

The tainting of fish prevented their acceptance at market, however, as late as 1964 (Millest and Neil, 1961; Neil, 1964). At that time an expansion of mill capacity was proposed. It was decided, therefore, to determine the incidence of foreign flavour in fish from the Spanish River before mill expansion took place. The results of this study would provide a basis of comparison for changes in fish flavour in the years to come.

This report presents the results of panel tests to evaluate the odour of river water and flavour of fish collected from the Spanish River in the summer of 1965.

METHODS AND PROCEDURES

Threshold Odour

Samples of river water were collected by M.G. Johnson and G.E. Owen of the Biology Branch, OWRC, on June 16 and 17, 1965. These samples were shipped by Railway Express and received at the laboratory on June 18. Two odour evaluation sessions were

held that afternoon and the samples were held under refrigeration until the 21st when the tests were completed.

Tests were held in an unused, air-conditioned room. All glassware was washed with non-perfumed detergent and rinsed with odour-free water to 200 ml and heated to $60 \pm 2^{\circ}\text{C}$ in stoppered flasks according to standard procedure (A.P.H.A. 1960). Dilutions of the samples were presented in order of increasing concentration with a flask of odour-free water for comparison. An unknown blank of odour-free water was always included in the series. The panel of judges consisted of five members of the laboratory staff.

Threshold odours for each panelist were obtained by noting the dilution number of the lowest concentration where odour was detected. Geometric mean thresholds were obtained from these.

Fish Flavour

Taste Panel

The taste panel consisted of six persons on the staff of the laboratory who professed no dislike for fish and were able to attend the sessions regularly. Three of the six had participated in previous taste tests. Four were non-smokers.

Procurement of Fish

Nine pickerel, one pike and one smallmouth bass were obtained from the Spanish River at Massey on June 14, 1965. Five pickerel were obtained from Onaping Lake for controls. These fish were eviscerated and frozen before transport to the laboratory in Toronto. On July 9, seven fresh pickerel fished from the North Channel near the mouth of the Spanish River were received from Mr. R. Vance, commercial fisherman, Spanish, Ontario. All fish were held in a

freezer in the laboratory until the day before the taste tests at which time they were transferred to a refrigerator for thawing.

Preparation of Samples

Samples of about one cubic inch were taken from a fillet cut from the meatiest part of the fish between the dorsal and lateral lines. Skin and large bones were removed. The samples were placed in a new aluminum foil baking cups and covered tightly with numbered pieces of heavy foil. The numbers corresponded with those on a chart of the order of presentation of samples, known only to the preparator.

The cups of fish were placed on enamelled trays and baked in an oven at 300°F for 15 minutes. They were then taken to the test room where they were kept warm under a heat lamp for a maximum of 20 minutes.

The Taste Tests

Three testing sessions, in addition to a "warm-up" test, were held in an unoccupied, air-conditioned room on October 14 and 15. The sessions were scheduled at least an hour after meals and panelists were asked to refrain from smoking for half an hour before each test. Women judges were asked not to use perfume and to remove their lipstick before tests. All panelists washed their hands with "Ivory" soap before handling the samples. Glassware used had been washed with non-perfumed detergent and rinsed with taste-free water.

Each panelist used an individual "place-setting" consisting of a dish of unsalted soda crackers, waste containers, a fork, paper cup, flask of rinse water and a data sheet. Rinse water was made

by adding 2 tablespoons of lemon juice per quart of taste-free water as suggested by Baldwin et al. (1961).

For each session the panelists were presented with a sample of warm fish marked "Control" and seven samples identified by number only. They were instructed to rinse the mouth, chew a piece of "Control" fish, chew a cracker and rinse again, placing all waste in the containers provided. The numbered samples were then tasted in turn, with a cracker chewed and the mouth rinsed between each one. The presence or absence of foreign flavour as compared with the control was recorded as follows:

0	absent
+	barely perceptible
++	definite
+++	strong

Samples from all locations were presented at each session. One unknown control sample was always included. The order of presentation of samples from the different locations was changed for each test.

Since no control specimens for the single bass and pike were available, the panel was asked merely to indicate whether or not these fish were acceptable for eating.

RESULTS AND DISCUSSION

Odour of Water

The geometric mean threshold odour values obtained are given in Table 1. The data indicate that the threshold odour of the water increased from a minimum of 2.3 above Espanola to a maximum of 166.8 immediately below Espanola, decreased to 57.0 at Massey and to 29.7

at Spanish. Thus, 33 miles downstream of Espanola the threshold odour of the water was still 12 times as great as that observed upstream of the town. This confirms previous field observations that the odour persisted in the river to its mouth. The maximum datum obtained is consistent with the threshold found by OWRC personnel in October, 1964.

Table 1. Threshold odour of water
from the Spanish River, June, 1965

Sample Location	Geometric Mean Threshold Odour
Upstream of Espanola*	2.3
100 yd. downstream of K.V.P.	166.8
Massey	57.0
Spanish	29.7

* at Highway 17

In view of the fact that two malodorous wastes had been removed from the K.V.P. Company effluent, it might be expected that the odour of the river water would have been less intense. However, the effect of remaining odorous wastes could have become pronounced over the years as Kraft pulp production increased.

Fish Flavour

The percentage incidence of foreign flavour in pickerel from Onaping Lake, Spanish River at Massey and the North Channel is given in Table 2. The data are based on the total number of samples presented from each location and include the percentage of samples falling into each intensity category.

Table 2. Incidence of foreign flavour in pickerel samples

Collection Site	Number of Samples	Foreign Flavour				Positive	TOTAL Def. or Strong
		0	+	++	+++		
Onaping Lake	No. 17	10	5	2	0	7	2
	% 100	58.8	29.4	11.8	0.0	41.2	11.8
Massey	No. 51	8	16	16	11	43	27
	% 100	15.7**	31.4	31.4**	21.6(**)	84.3**	52.9**
North Channel	No. 39	6	14	12	7	33	19
	% 100	15.4**	35.9	30.8**	17.9(*)	84.6**	48.7**

* Significantly different from control at 5% level
 ** Significantly different from control at 1% level
 (**) Based on assumed incidence of one control sample +++

Reference to Table 2 shows that of the 17 control samples presented 41.2 per cent were rated positive for foreign flavour, 11.8 per cent definite or strong. Due to the subjective nature of taste panel tests, a certain percentage of control samples can be expected to be rated as positive. The incidence of total positive found here is somewhat higher than usually encountered, due perhaps to the small number of samples available.

Of the 51 samples of pickerel from Massey, 84.3 per cent were classified as having a foreign flavour; 52.9 per cent as definite or strong. The data for the samples from North Channel were similar to these: 84.6 per cent positive and 48.7 per cent definite or strong.

The intensity of foreign flavour in fish from Massey and North Channel was similar. Of the samples from Massey 31.4 per cent were classed as barely perceptible, 31.4 per cent as definite and

21.6 per cent as strong. For the samples from North Channel these data were, respectively, 35.9, 30.8 and 17.9 per cent.

Using the incidences of foreign flavour in control samples as those expected, the data for samples from the other locations were subjected to Chi Square tests. The results of these tests are indicated by asterisks (*) in Table 2. The incidence of samples positive for foreign flavour and of those rated definite or strong were significantly higher in samples from both Massey and the North Channel than in those from Onaping Lake.

In all categories of foreign flavour intensity except "barely perceptible", the data for Massey and North Channel samples were significantly different from those expected on the basis of the controls. (In order to apply the Chi Square test to the "strong" classification which yielded a datum of 0 for controls, it was necessary to assume an incidence of one positive sample, i.e., 6 per cent, in the controls.)

The foregoing discussion deals with foreign flavour in all fish samples from each location. To obtain an estimate of the number of individual pickerel which could be considered tainted, an arbitrary criterion of two-thirds of the samples from each fish rated definite or strong by the panel was adopted. On this basis none of the three fish from Onaping Lake was tainted. Four of the eight pickerel from Massey and four of the seven from the North Channel, however, were tainted.

When presented with the pike and bass specimens from Massey, five of the six panelists classified both as acceptable,

even though a few felt they had a barely perceptible foreign flavour.

As part of the Research Council's study of the Spanish River in 1950, pickerel from the river and another group from Lake Mindemoya were sent to the Fisheries Research Board at Halifax for taste panel evaluation. The report on these tests (Dymond and De Laporte, 1952) stated that on a scale of 0 (unacceptable) to 100 (perfect score) the fish from Lake Mindemoya averaged 64 per cent, those from the Spanish River, only 39 per cent. The latter had "an objectionable bad taste ----- somewhat like decaying mud". The present study indicates that a large percentage of pickerel from the lower river and adjacent North Channel still have an objectionable foreign flavour.

CONCLUSIONS AND RECOMMENDATIONS

The threshold odour of water from the Spanish River increased from 2.3 upstream of Espanola to 166.8 just downstream of the K.V.P. outfall then decreased to 57.0 at Massey and to 29.7 at Spanish. The data confirm field reports of Kraft mill odour persisting in the river to its mouth

The incidence of foreign flavour in yellow pickerel from the Spanish River at Massey and from the North Channel near the river mouth was significantly higher than that found in pickerel from Onaping Lake. Approximately half of the fish from both Massey and the North Channel were considered to be tainted.

Information obtained from the Industrial Wastes Division, OWRC, indicates that possible sources of odour- and taste-producing materials originating with the K.V.P. Company, Espanola, included:

any turpentine decanter underflow and hotwater accumulator overflow allowed to reach the sewers, losses from the brownstock washing area due to spillages and foaming, screen room effluents containing black liquor and possibly anti-foaming agents carried over in the pulp from brownstock washing operations, bleach plant effluents containing extracted organics, and any spills or losses occurring in the pulp mill, bleach plant and chemical recovery process.

In order to correct the taste and odour situation in the Spanish River and to prevent an increase in the problem with mill expansion, all malodorous wastes must be eliminated from the K.V.P. Company discharge to the river.

Taste panel tests on fish from the river should be repeated subsequent to mill expansion to determine any changes in the incidence of foreign flavour.

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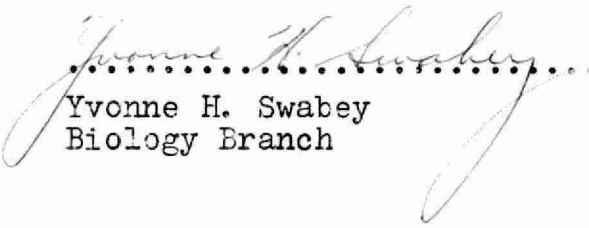
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